Vorticity dynamics in rotating flow: geophysical applications

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Vorticity dynamics in rotating flows are investigated using a Lagrangian Particle Method (LPM). The method is based on the point vortex discretization of an incompressible fluid with smooth vorticity distribution. Velocity is computed from the Biot-Savart integral and a quadrature scheme. A new remeshing technique is applied at regular time intervals to maintain spatial accuracy and minimize error due to particle distortion. Particles are inserted and removed adaptively to maintain resolution of the flow as small scale features develop. Applications related to atmospheric and oceanic fluid flows are presented in planar and spherical geometries and include interacting dipoles, Rossby-Haurwitz waves, Gaussian vortices, and a polar vortex model. Strategies for extending LPM into compressible flow regimes are discussed.